CODE DIVISION MULTIPLEXING COMMANDS ON A CODE DIVISION MULTIPLEXED CHANNEL

CROSS-REFERENCES

The present application claims priority from U.S. provisional application Ser. No. 60/448,269, entitled "REVERSE LINK DATA COMMUNICATION", filed on Feb. 18, 2003; U.S. provisional application Ser. No. 60/452,790, entitled "METHOD AND APPARATUS FOR A REVERSE LINK COMMUNICATION IN A COMMUNICATION SYSTEM", filed on Mar. 6, 2003; U.S. provisional application Ser. No. 60/470,225, entitled "METHOD AND APPARATUS FOR QUALITY OF SERVICE IN IS-2000 REVERSE LINK", filed on May 12, 2003; and U.S. provisional application Ser. No. 60/470,770, entitled "OUTER-LOOP POWER CONTROL FOR REL. D", filed on May 14, 2003

FIELD

The present invention relates generally to wireless communications, and more specifically to a novel and improved method and apparatus for code division multiplexing commands or signals on a code division multiplexed channel.

BACKGROUND

Wireless communication systems are widely deployed to provide various types of communication such as voice and data. These systems may be based on code division multiple access (CDMA), time division multiple access (TDMA), or some other multiple access techniques. A CDMA system provides certain advantages over other types of systems, including increased system capacity.

A CDMA system may be designed to support one or more CDMA standards such as (1) the "TIA/EIA-95-B Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular System" (the IS-95 standard), (2) the standard offered by a consortium named "3rd Generation Partnership Project" (3GPP) and embodied in a set of documents including Document Nos. 3G TS 25.211, 3G TS 25.212, 3G TS 25.213, and 3G TS 25.214 (the W-CDMA standard), (3) the standard offered by a consortium named "3rd Generation Partnership Project 2" (3GPP2) and embodied in "TR-45.5 Physical Layer Standard for cdma2000 Spread Spectrum Systems" (the IS-2000 standard), and (4) some other standards.

In the above named standards, the available spectrum is shared simultaneously among a number of users, and techniques such as power control and soft handoff are employed to maintain sufficient quality to support delay-sensitive services, such as voice. Data services are also available. More recently, systems have been proposed that enhance the capacity for data services by using higher order modulation, very fast feedback of Carrier to Interference ratio (C/I) from the mobile station, very fast scheduling, and scheduling for services that have more relaxed delay requirements. An example of such a data-only communication system using these techniques is the high data rate (HDR) system that conforms to the TIA/EIA/IS-856 standard (the IS-856 standard).

In contrast to the other above named standards, an IS-856 system uses the entire spectrum available in each cell to transmit data to a single user at one time, selected based on link quality. In so doing, the system spends a greater percentage of time sending data at higher rates when the channel is good, and thereby avoids committing resources to support transmission at inefficient rates. The net effect is higher data capacity, higher peak data rates, and higher average throughput.

Systems can incorporate support for delay-sensitive data, such as voice channels or data channels supported in the IS-2000 standard, along with support for packet data services such as those described in the IS-856 standard. One such system is described in a proposal submitted by LG Electronics, LSI Logic, Lucent Technologies, Nortel Networks, QUALCOMM Incorporated, and Samsung to the 3rd Generation Partnership Project 2 (3GPP2). The proposal is detailed in documents entitled "Updated Joint Physical Layer Proposal for 1xEV-DV", submitted to 3GPP2 as document number C50-20010611-009, Jun. 11, 2001; "Results of L3NQS Simulation Study", submitted to 3GPP2 as document number C50-20010820-011, Aug. 20, 2001; and "System Simulation Results for the L3NQS Framework Proposal for cdma2000 1xEV-DV", submitted to 3GPP2 as document number C50-20010820-012, Aug. 20, 2001. These, and related documents generated subsequently, such as Revision C of the IS-2000 standard, including C.S0001.C through C.S0006.C, are hereinafter referred to as the 1xEV-DV proposal.

In order to coordinate usage of the forward and reverse link in an efficient manner, a system, the 1xEV-DV proposal, for example, may need to direct feedback from a base station to a number of supported mobile stations. It is common for such feedback to be transmitted on one or more control channels. In a CDMA system, such control channels may be multiplexed with other control and/or data channels using Code Division Multiplexing (CDM). Traditionally, to reach a plurality of mobile stations, a control channel is time-shared to transmit to each of the mobile stations. Thus, a control channel may be multiplexed using Time Division Multiplexing (TDM) to incorporate signals or commands for multiple mobile stations. The resultant TDM control channel may then be transmitted along with other channels, whether control, voice, or data, using CDM. One example of such a TDM on CDM channel is the power control channel in cdma2000.

As is well known in wireless system design, when a channel can be transmitted using less power for the same reliability, the capacity of the system may be improved. Thus, there is a need in the art for more efficient control channels. Furthermore, TDM on CDM channels may have peak power requirements that are inefficient, or even unattainable given system design parameters. There is therefore a need in the art for control channels that can reach a plurality of mobile stations, thus allowing for efficient use of the shared communication resource, while meeting peak power design constraints as well as reducing the amount of system capacity allocated to such control.

SUMMARY

Embodiments disclosed herein address the need for efficient signaling to a plurality of mobile stations. In one embodiment, each of a plurality of symbol streams are encoded with one of a plurality of covering sequences, the covered symbol streams are combined to form a Code Division Multiplexed (CDM) signal, and the CDM signal is further covered by another covering sequence for code division multiplexing with one or more additional signals for transmission to a remote station. In another embodiment, a plurality of CDM signals are formed from the covered symbol streams, and the plurality of CDM signals are Time Division Multiplexed (TDM) prior to the further covering. In other embodiments, decovering and demultiplexing is performed